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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

The reference		See Netification	of Transmittal of International	
Applicant's or agent's file reference PC471CF	OR FURTHER ACTION	Preliminary Exa	mination Report (Form PCT/IPE	A/416)
ilitorriadorial approximation	ernational filing date (daylmor 2.12.2003	nth/year)	Priority date (day/month/year) 20.12.2002	
International Patent Classification (IPC) or both r F16D65/14	ational classification and IPC			
Applicant AKTIEBOLAGET SKF et al				
This International preliminary examin Authority and is transmitted to the ap	ation report has been prepolicant according to Article	ared by this inter 36.	national Preliminary Examir	ning
2. This REPORT consists of a total of 5	sheets, including this cov	er sheet.	•	
This report is also accompanie been amended and are the bas (see Rule 70.16 and Section 6	ic for this report and/or spe	eets containillu i	Bullications made before the	/hich have s Authority
These annexes consist of a total of 5	sheets.			
This report contains indications relat	ing to the following items:			
Basis of the opinion				•
			,	
III Non-establishment of op	inion with regard to novelty	y, inventive step	and industrial applicability	•
IV Lack of unity of invention				
V Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement				
VI Certain documents cited			•	
VII Certain defects in the inf	ernational application	٠		
VIII Certain observations on	the international application	on		•
Date of submission of the demand	Dat	te of completion of	ihis report	
19.07.2004	13	.12.2004		
Name and mailing address of the international preliminary examining authority:	Aut	thorized Officer		Sealteches follows
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 52365	6 epmu d	artinvalet, C-I		
Fax: +49 89 2399 - 4465	Te	lephone No. +49 8	9 2399-8185	Spring and or other

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/EP 03/14703

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1. With regard to the **elements** of the international application (Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)):

	Desc	ription, Pages					
	2-7		as originally filed				
	1, 1a		received on 19.11.2004 with letter of 17.11.2004				
	Clair	ns, Numbers					
	1-14	•	received on 19.11.2004 with letter of 17.11.2004				
	Drav	vings, Sheets					
	1/5-5		as originally filed				
2.	With lang	regard to the langua uage in which the inte	ge, all the elements marked above were available or furnished to this Authority in the rnational application was filed, unless otherwise indicated under this item.				
			lable or furnished to this Authority in the following language: , which is:				
			nslation furnished for the purposes of the international search (under Rule 23.1(b)).				
		the language of public	cation of the international application (under Rule 48.3(b)).				
		Rule 55.2 and/or 55.3					
3.	With inte	n regard to any nucleo rnational preliminary e	otide and/or amino acid sequence disclosed in the international application, the examination was carried out on the basis of the sequence listing:				
		contained in the international application in written form.					
		was a state of a subjection in computer readable form					
		graphical furnished subsequently to this Authority in written form.					
		in the international application as filed has been furnished.					
		The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.					
4	. The	e amendments have re	esulted in the cancellation of:				
		the description,	pages:				
		the claims,	Nos.:				
		the drawings,	sheets:				

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/EP 03/14703

5.	This report has been established as if (some of) the amendments had not been made, since they ha been considered to go beyond the disclosure as filed (Rule 70.2(c)).	ıve
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(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement ·

Novelty (N)

Yes: Claims

1-14

Inventive step (IS)

Yes: Claims

No:

Claims

Claims.

1-14

1-14

Industrial applicability (IA)

Yes: Claims

No: Claims

2. Citations and explanations

see separate sheet

Re Item V

Reasoned statement with regard to novelty and inventive step; citations and explanations supporting such statement

Reference is made to the following document:

D1: D1: WO 01/70552 A (BOSCH GMBH ROBERT (2001-09-27)

NOVELTY

Claim 1

The present application meet the criteria of Article 33(1) PCT, because the subject-matter of claim 1 is new in the sense of Article 33(2) PCT.

The document **D1** is regarded as being the most relevant state of the art discloses: an electro-mechanical screw actuator assembly (10), comprising:

a housing fixable to a motor vehicle,

an electric motor (18) mounted within the housing and comprising a stator fixed to the housing and a rotor,

a screw mechanism (48) including a translatable nut (62) and a central screw (50) rotatable along a given axis,

a gear reduction means (34) disposed between the rotor and the screw mechanism for provoking a translation of the nut (62),

wherein the housing is secured to or integral with a supporting element of essentially tubular cylindrical shape extending within the housing coaxial to said axis, wherein the supporting element externally rotatably supports the rotor of the electric motor, and internally rotatably supports the nut of the screw mechanism. (Fig.3).

INVENTIVE STEP

The subject-matter of claim 1 differs from this known electro-mechanical screw actuator assembly in that the supporting member supports externally at least one fixed gear of the gear reduction means.

The problem to be solved by the present invention may be regarded as reducing the play between the transmission members of the assembly.

The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons: the prior art documents do not suggest the differencing features.

Dependent claims 2-14

Claims 2-14 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

FURTHER REMARK:

The features introduced in claim 3 concerning the axial cavity (24) are not mentioned in claim 1 but in claim 2, so claim 3 should be dependent from claim 2.

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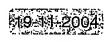
An electro-mechanical screw actuator assembly

The present invention refers to an electro-mechanical screw actuator assembly of the type mentioned in the preamble of claim 1.

Actuator assemblies of the above type are known, for example, from US-6 315 092. These actuators are applied in various fields, for example in the automotive field for actuating brakes, friction clutches, gearboxes, etc. An electric motor, mounted within a housing fixable to the vehicle, drives for rotation a nut member of a screw mechanism through a gear reduction system. The screw mechanism comprises a screw connected to a piston actuating head which is imparted a reversible linear motion with a high actuating force.

A problem encountered with conventional electro-mechanical actuator assemblies is due to the play between the various transmission members of the assembly, that are generally cascade connected. The tolerance of the couplings between the transmission members add up, allowing misalignment between the rotation or translation axes of these members, that are so subjected to early and non-uniform wear. Particularly, with use, the gears of the planetary reduction system have a tendency to wear very quickly if they are not kept correctly aligned parallel to the central longitudinal axes of the actuator, that coincides with the axis of translation of the piston member. An excessive increase of the play and the consequent misalignment of the axes of the transmission members leads to a loss of efficiency of the actuator assembly and shortens its life.

WO 01/70552 A discloses an electro-mechanical screw actuator assembly, comprising:



- a housing fixable to a motor vehicle,
- an electric motor mounted within the housing and comprising a stator fixed to the housing and a rotor,
- a screw mechanism, including a translatable nut and a central screw rotatable translatable along a given axis,
- a gear reduction means disposed between the rotor and the screw mechanism for provoking a translation of the nut. The housing is secured to or integral with a supporting element of essentially tubular cylindrical shape extending within the housing coaxial to said axis, wherein the supporting element externally rotatably supports the rotor of the electric motor, and internally rotatably supports the nut of the screw mechanism.

The object of the present invention is therefore to provide an electro-mechanical screw actuator assembly, adaptable to



CLAIMS

1. An electro-mechanical screw actuator assembly, of the type comprising:

a housing (11) fixable to a motor vehicle,

an electric motor (30) mounted within the housing (11) and comprising a stator (31) fixed to the housing (11) and a rotor (34),

a screw mechanism (60), including a rotatable nut (61) and a central screw (62) translatable along a given axis (x),

gear reduction means (50) disposed between the rotor (34) and the screw mechanism (60) for provoking a translation of the screw (62),

wherein the housing (11) is secured to or integral with a supporting element (21) of essentially tubular cylindrical shape extending within the housing (11) coaxial to said axis (x), and wherein the supporting element (21)

externally, rotatably supports the rotor (34) of the electric motor (30), and

internally, rotatably supports the nut (61) of the screw mechanism (60);

characterized in that the supporting member (21) supports externally at least one fixed gear (55) of the gear reduction means (50).

- 2. An actuator assembly according to claim 1, characterized in that the supporting member (21) forms an axial cavity (24) for accommodating and axially guiding a piston member (70) fixed to or integral with the screw (61) of the screw mechanism (60).
- 3. An actuator assembly according to claim 1, characterized in that at the interface between the axial



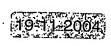
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cavity (24) of the supporting member (21) and the piston member (70) there is provided an axial splined coupling or a form coupling (26) for preventing rotation of the screw (62) and/or the piston member (70) with respect to the housing (11).

- 4. An actuator assembly according to claim 1, characterized in that the supporting member (21) is formed by a rigid body (20) having also a supporting means (23) for mounting the stator (31) of the electric motor (30).
- 5. An actuator assembly according to claim 1, characterized in that the gear reduction means (50) include a planetary gear reduction system.
- 6. An actuator assembly according to claim 5, characterized in that the rotor (34) forms a radial flange (36) that serves as a carrier for a plurality of satellite gears (52).
- 7. An actuator assembly according to claim 6, characterized in that each of the satellite gears (52) has two toothed portions (53, 54), of which:
- a first toothed portion (53) meshes with a fixed gear (55) fast with the tubular supporting member (21) and
- a second toothed portion (54) meshes with a gear (56) fast for rotation with the nut (61).

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- 8. An actuator assembly according to claim 1, characterized in that the screw mechanism (60) is rotatably supported at an end thereof by an angular contact ball bearing (44).
- 9. An actuator assembly according to claim 8,



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characterized in that the radially outer raceway of the angular contact ball bearing (44) is formed at least partially by a sleeve member (45) axially locked onto the housing (15).

- 10. An actuator assembly according to claim 9, characterized in that the sleeve member (45) is axially locked onto the housing (11) by cold forming an end portion (47') of the sleeve member (45) deformed in a radially outer direction against a radial wall (14) of the housing (11).
- 11. An actuator assembly according to claim 9, characterized in that the radially outer raceway of the angular contact for bearing (44) is formed entirely by a sleeve member (45), whilst the radially inner raceway is formed partly by the nut (61) and partly by a separate annular member (481) axially locked (491) onto the nut.
- 12. An actuator assembly according to claim 11, characterized in that the separate annular member (48') is axially locked onto the nut (61) by cold forming an end portion (61') of the nut that is deformed in a radially outer direction against a radial wall of the separate ring (48').
- 13. An actuator assembly according to claim 1, characterized in that the screw mechanism (60) includes a ballscrew.
- 14. An actuator assembly according to anyone of the preceding claims, characterized in that it is coupled with a brake caliper (A) for operating a braking force on a motor vehicle.

AMENDED SHEET